

Microsimulation Model Calibration During a Pandemic – How Big Data Saved the Day

I-126/US 321/Elmwood Avenue Bridge Replacement
Columbia, SC





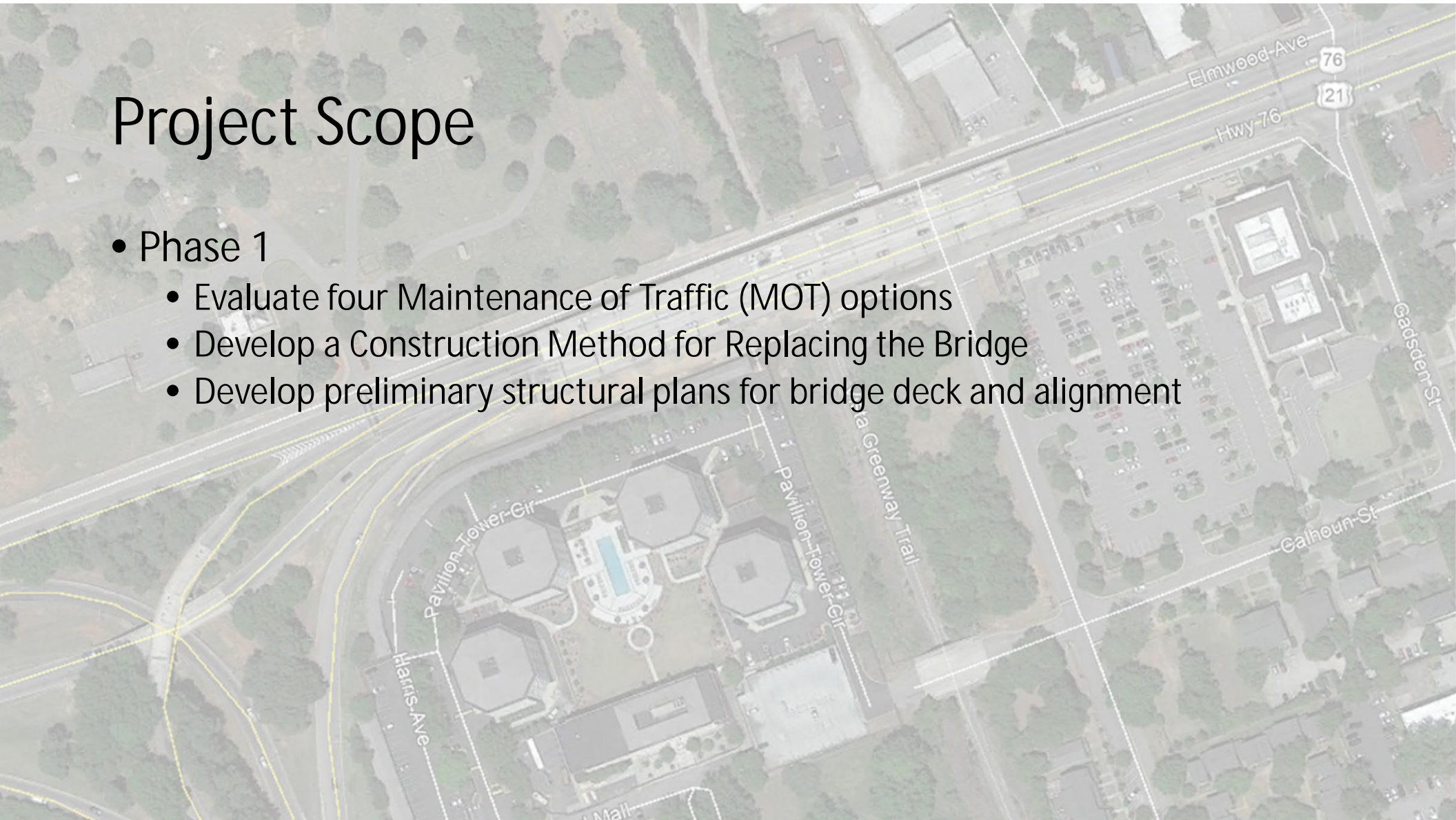
Project Location: Columbia, SC
Elmwood Avenue Bridge





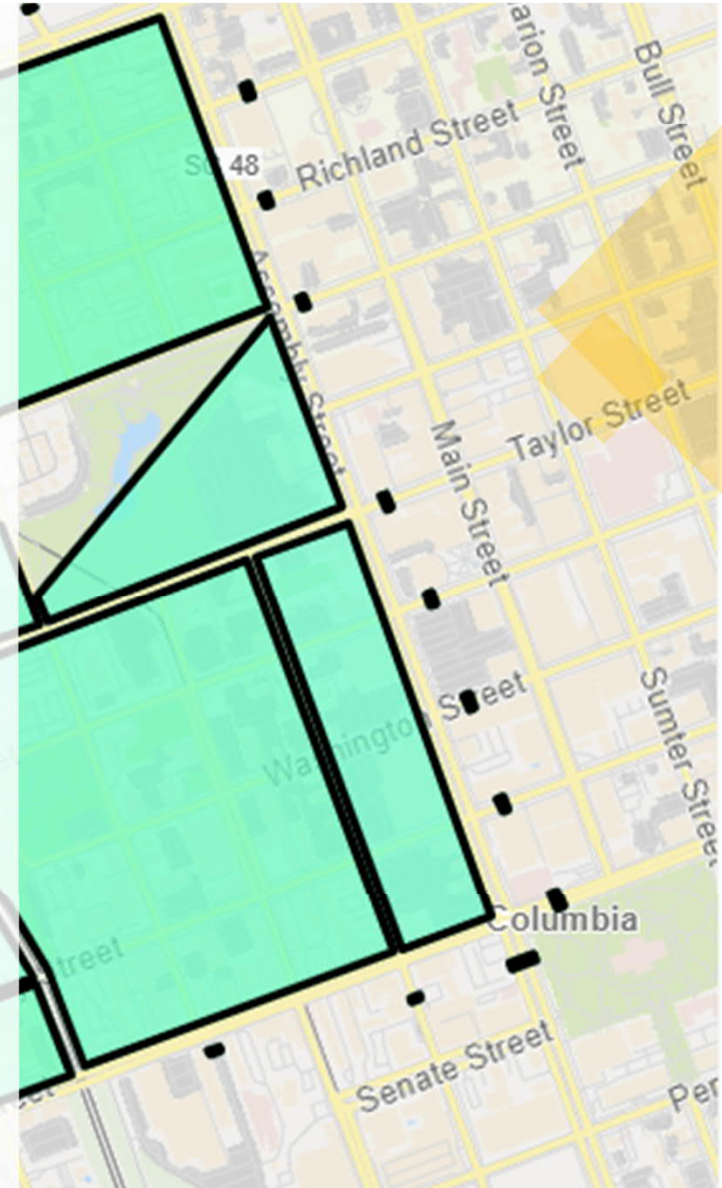
Project Scope

- Phase 1
 - Evaluate four Maintenance of Traffic (MOT) options
 - Develop a Construction Method for Replacing the Bridge
 - Develop preliminary structural plans for bridge deck and alignment



MOT Evaluation Tasks


- Prior to the COVID-19 Pandemic, the MOT evaluation included:
 - AM and PM peak hour Turning Movement Counts (TMC) at 20 intersections
 - Vehicle and Classification counts on the ramps at the I-126/Huger Street/Elmwood Avenue Interchange
 - Pedestrian and Bicyclist Counts in proximity to the bridge
 - Development of Origin-Destination matrices for modeling
 - Creation and calibration of an Existing Conditions TransModeler microsimulation
 - Testing of four variations of MOT during construction
 - Full Closure, Four-lane bridge, Three-lane bridge, Two-lane bridge



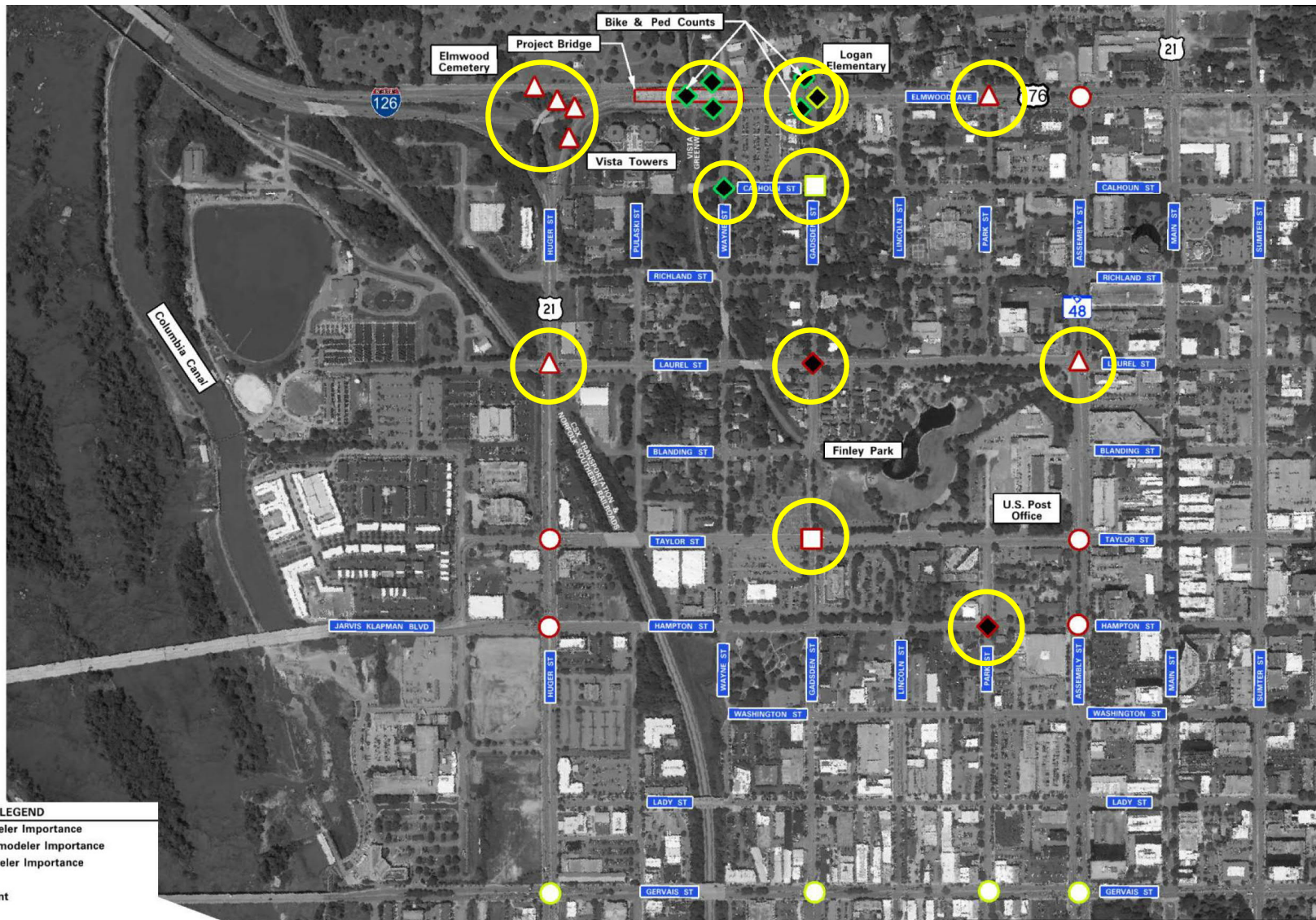
How was the Project Impacted by COVID-19?



How will we
collect data
now?



How will we
calibrate our
microsimulation
model?

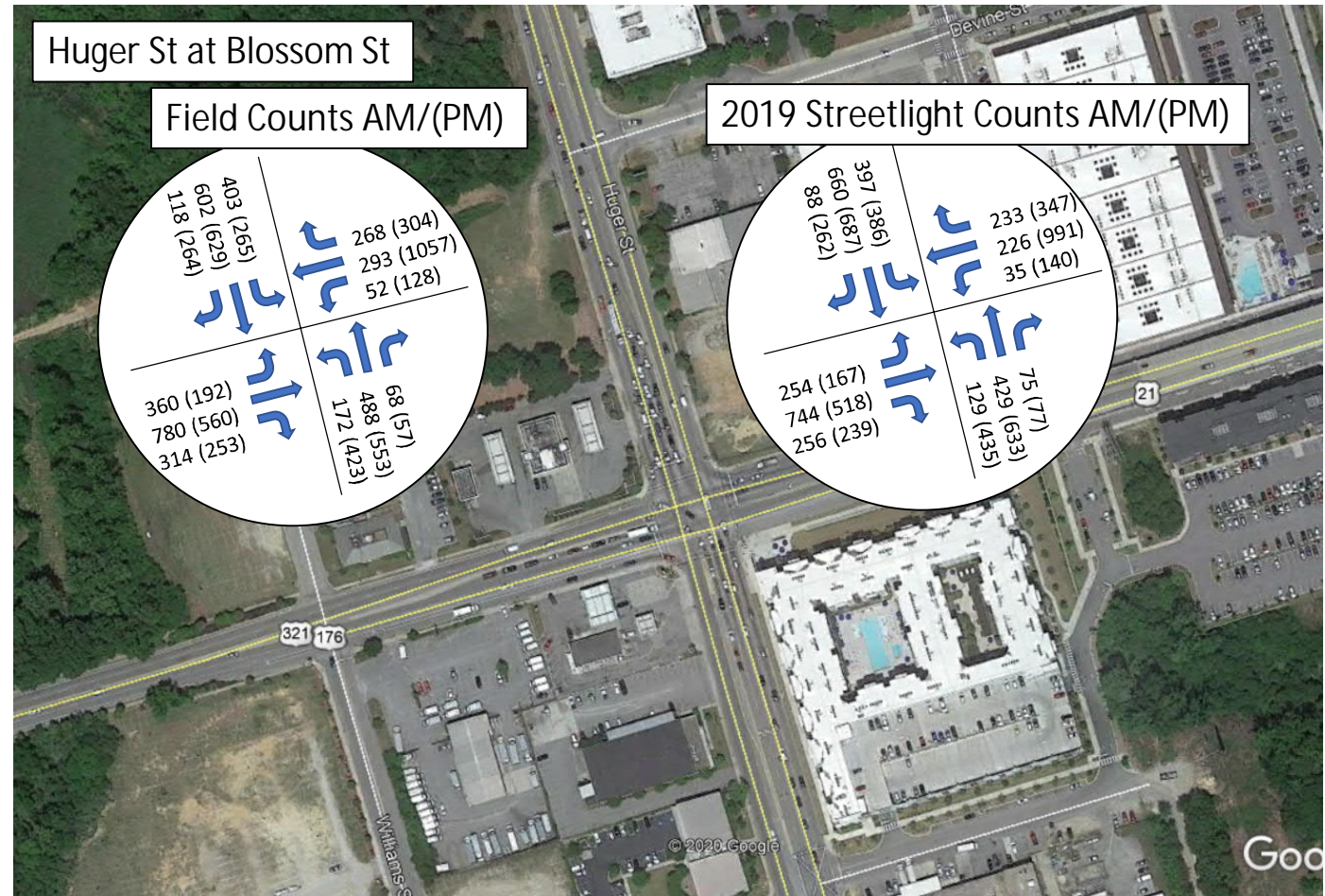


LEGEND

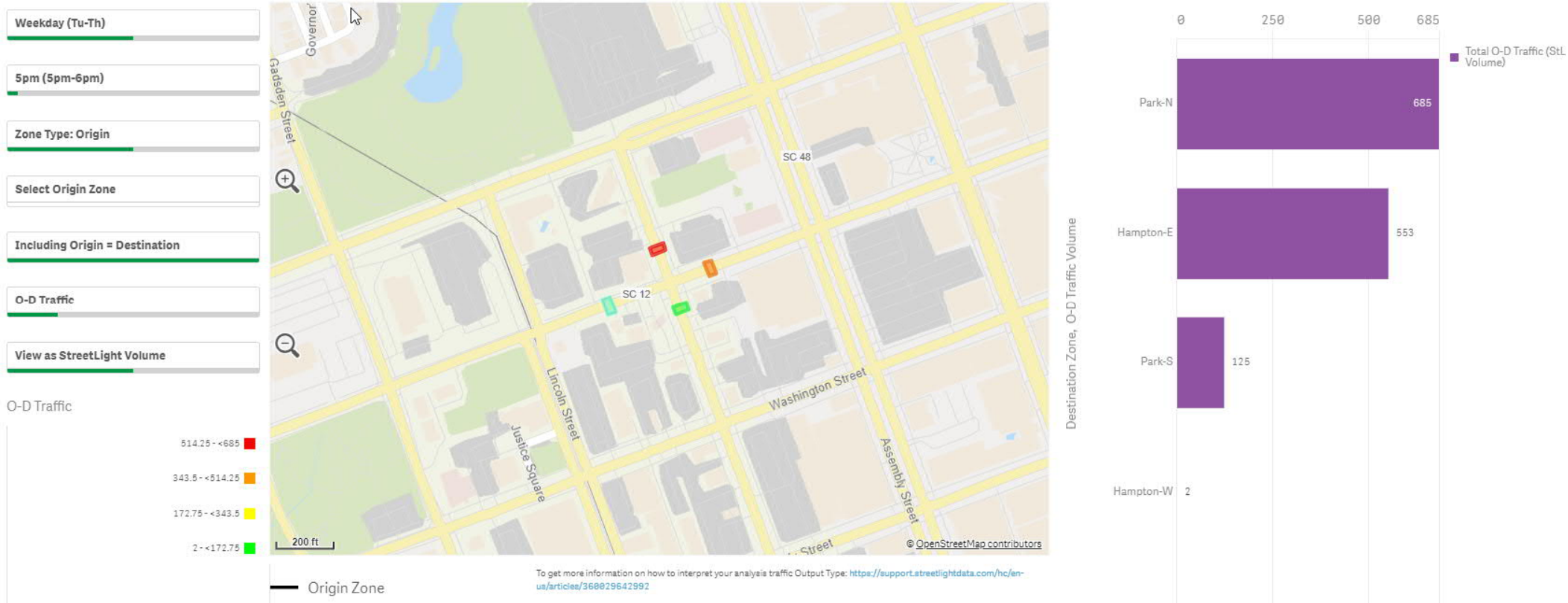
- High Transmodeler Importance
- Medium Transmodeler Importance
- Low Transmodeler Importance
- 2019 Count
- 2016 / 2017 Count
- △ 2015 Count
- ◆ No Data

Can we Use StreetLight to Approximate TMCs?

- Reached out to SCDOT to explore this as an option
- After discussing, we decided that StreetLight was an appropriate tool for filling in gaps in the TMC data



Using StreetLight Data to Generate TMCs

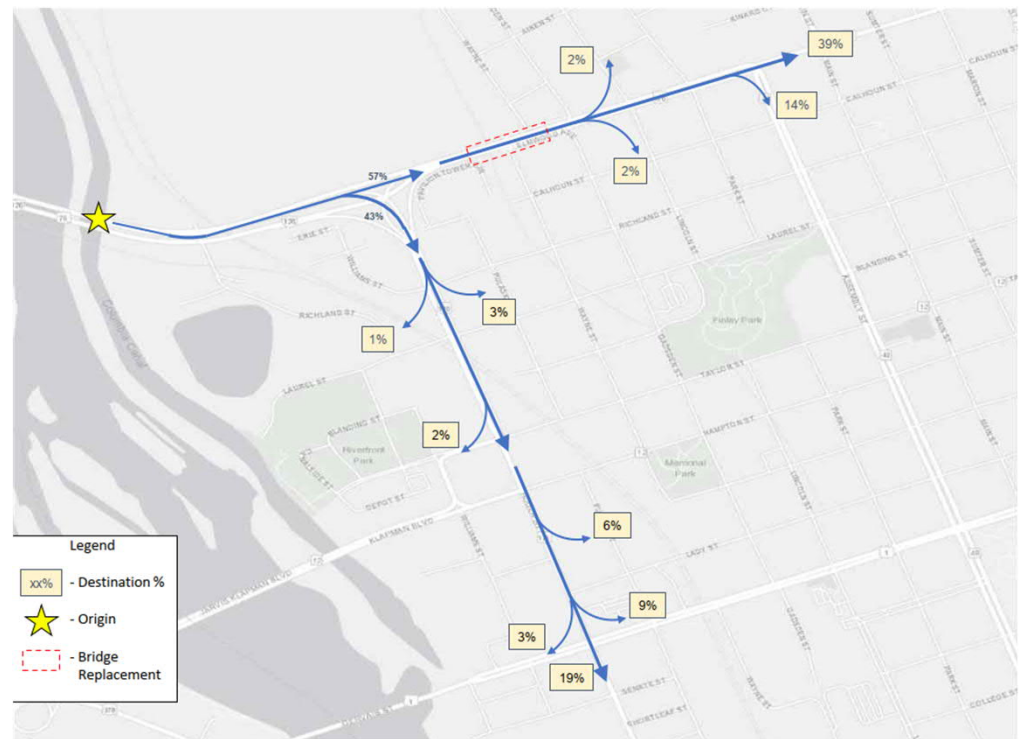
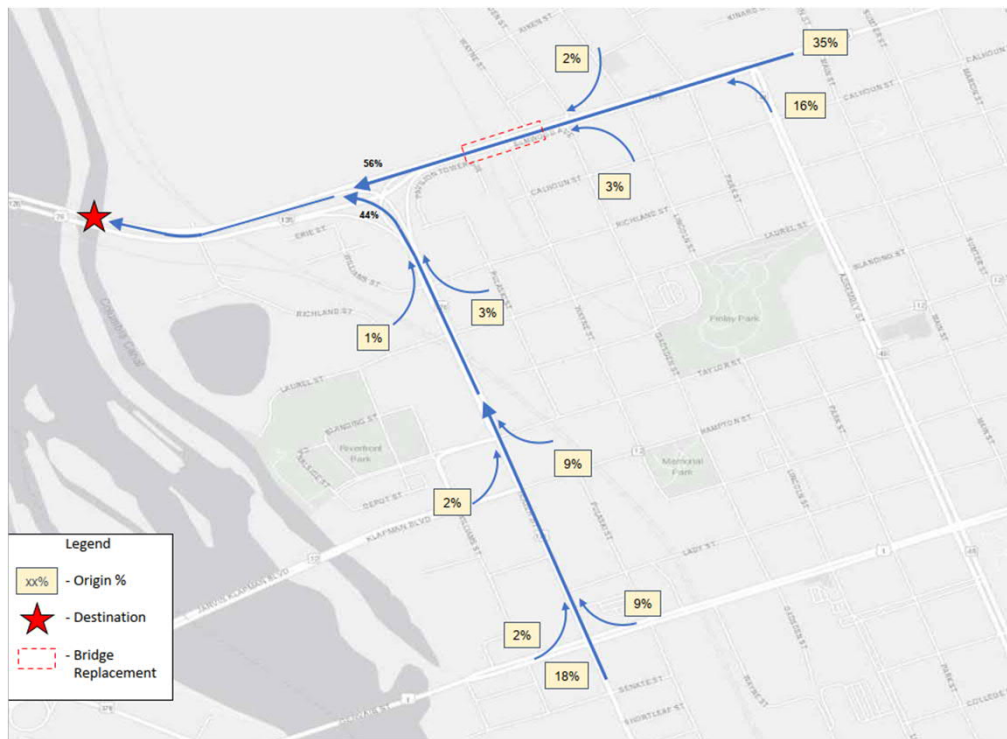


Using StreetLight Data to Generate TMCs

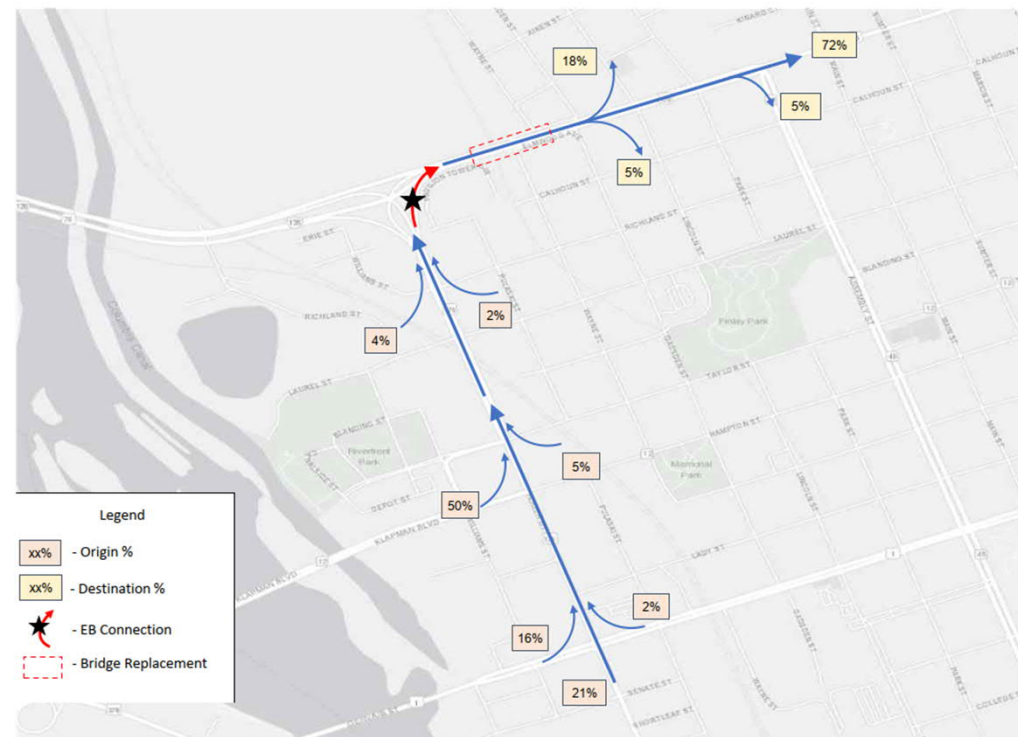
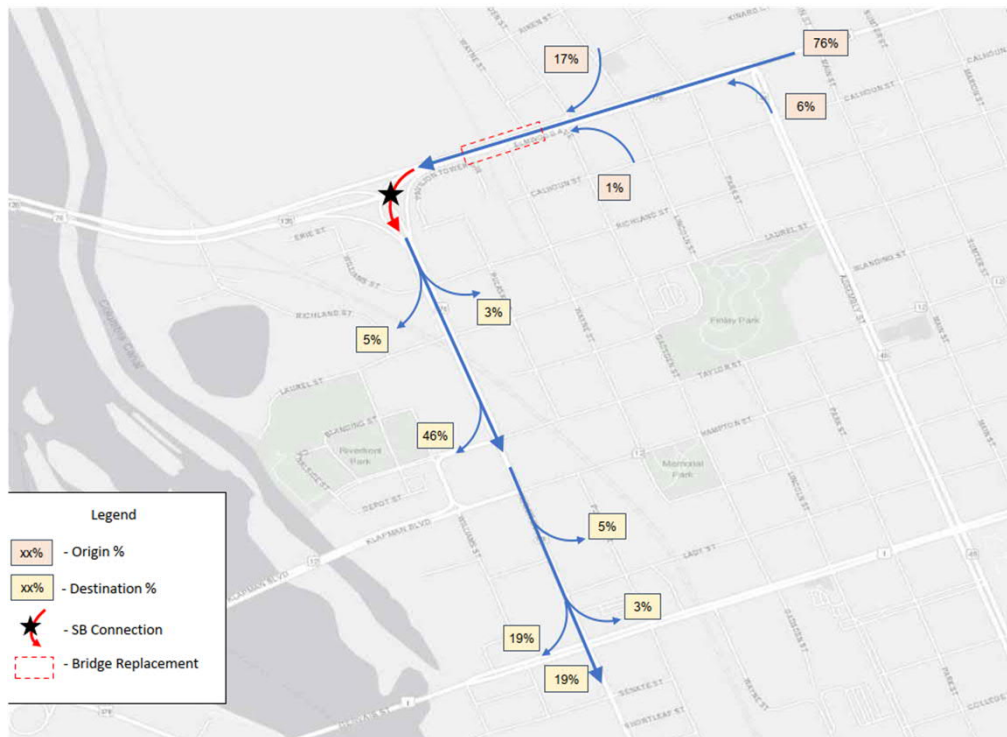
Using StreetLight Data to Generate Origin-Destination Matrices

[illegible]

Mapping Origin-Destination Pairs



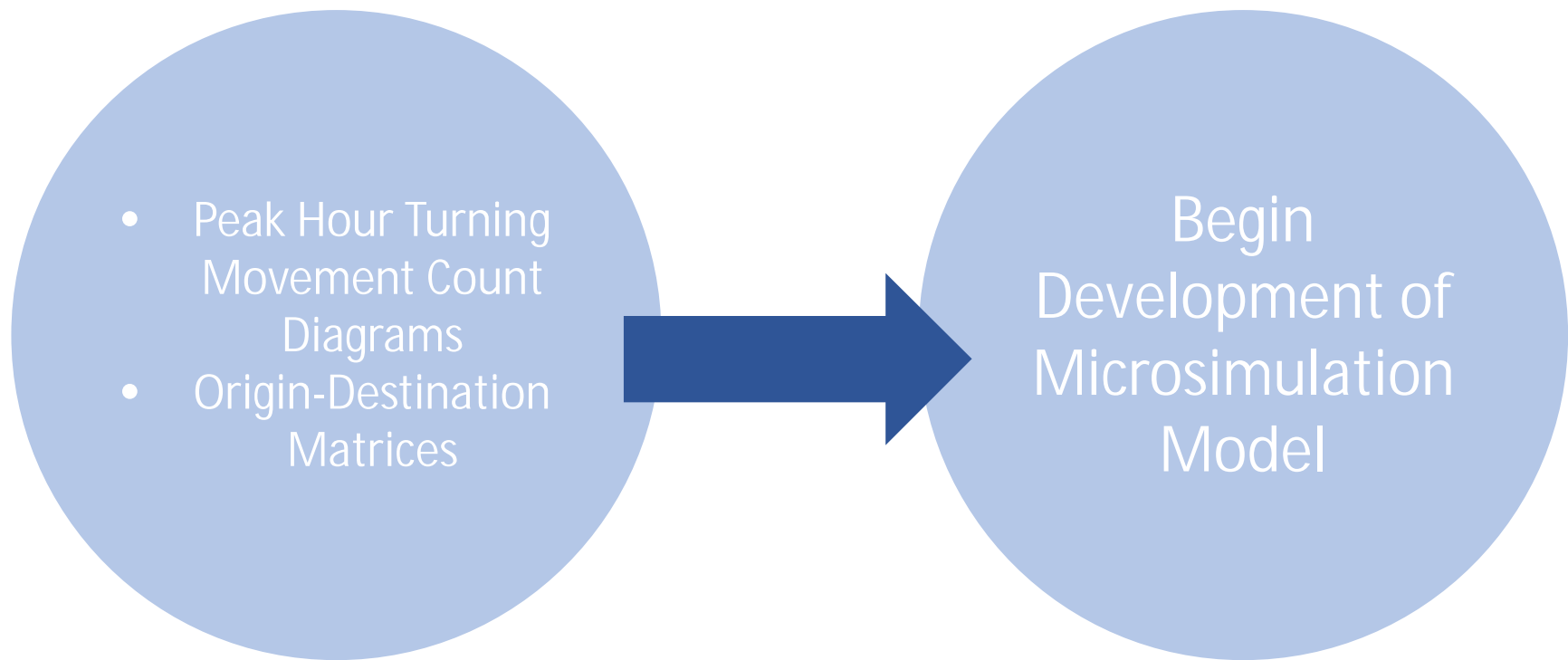
Mapping Origin-Destination Pairs



Origin-Destination Matrices

			Destination														90 on HDR															Total			
			1	7	8	11	16	19	23	26	27	29	32	33	36	40	51	55	59	60	65	70	72	76	81	83	94	95	97	100	108	114	Sum	Origins	
	1		1	0	11	43	3	0	0	2	25	4	10	20	3	1	17	2	2	0	3	2	7	0	1	1	10	0	0	0	0	0	0	166	163
	2		2	19	491	41	4	36	7	31	716	74	111	140	42	7	130	31	14	0	115	19	18	20	42	37	51	11	0	10	15	13	7	2254	2256
	7	Origin	7	6	0	616	8	9	7	7	93	15	182	32	13	1	31	14	8	0	48	7	26	7	9	19	19	17	0	10	14	13	0	1229	1225
	11		11	0	4	6	0	0	0	3	4	1	1	6	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	29	30
	16		16	3	13	61	0	0	0	59	49	3	5	50	4	1	1	1	1	0	2	1	0	0	0	1	0	0	0	0	0	0	0	256	261
	19		19	2	4	27	0	0	0	1	5	1	1	2	0	0	3	0	0	0	1	0	0	0	3	4	8	0	0	0	0	0	0	63	58
	23		23	2	15	152	0	9	2	0	8	3	26	84	3	1	20	2	9	0	4	1	6	0	3	3	20	0	0	0	0	0	0	373	373
	26		26	21	94	1179	5	12	10	9	0	16	107	366	14	1	146	7	5	0	22	11	15	6	12	8	42	5	0	3	6	9	1	2132	2127
	27		27	3	30	258	6	12	0	6	25	0	62	626	9	1	40	5	6	0	14	4	17	0	3	2	18	0	0	2	5	10	0	1166	1160
	29		29	7	258	129	4	6	3	9	145	16	0	27	21	5	58	8	5	0	301	16	10	6	3	2	11	7	0	4	9	6	0	1074	1074
	32		32	9	62	155	5	9	4	27	284	154	51	0	144	1	43	8	7	0	46	9	15	9	7	21	13	4	0	3	7	6	0	1103	1103
	33		33	4	7	95	2	2	3	3	13	19	31	135	0	1	41	6	2	0	11	2	7	5	6	0	12	0	0	0	0	0	0	408	404
	36		36	1	5	41	2	0	0	0	6	2	41	1	2	0	4	1	0	0	37	0	7	0	1	0	0	0	0	0	0	0	0	149	146
	40		40	22	29	414	7	2	5	32	232	79	106	103	28	1	0	41	26	0	218	23	17	39	22	6	22	6	0	4	10	6	0	1499	1499
	51		51	4	8	129	0	2	0	3	11	9	70	42	5	1	57	0	3	0	18	5	0	13	3	1	8	3	0	1	5	6	0	406	406
	55		55	9	0	94	0	0	2	4	12	6	17	101	6	0	25	1	0	0	4	3	0	0	4	2	8	0	0	0	0	0	1	302	300
	59	Post	59	1	0	5	0	0	0	1	3	4	2	7	1	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	30	30
	60		60	10	67	267	4	9	7	13	28	20	470	109	12	11	174	43	19	0	0	33	21	16	26	12	24	11	0	14	21	21	0	1459	1459
	65		65	1	7	112	3	2	0	2	15	11	61	11	5	1	16	14	7	0	100	0	12	9	6	6	19	8	0	0	0	0	0	426	425
	70		70	0	13	21	0	0	0	11	13	2	3	22	4	0	4	0	0	0	5	0	0	0	1	1	0	0	0	0	0	0	0	103	108
	72		72	2	4	52	0	0	0	2	10	6	25	34	10	0	34	8	3	0	14	4	6	0	2	1	8	0	0	0	0	0	0	226	235
	76		76	9	6	155	0	2	4	2	13	4	15	69	3	0	24	2	17	0	6	2	0	0	0	2	29	0	0	0	0	0	1	366	374
	81		81	6	7	30	0	0	10	0	1	0	4	4	1	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	70	72
	83	NW	83	4	12	87	3	2	12	37	61	9	9	25	4	1	25	3	1	0	10	0	7	0	36	1	0	0	0	0	0	0	0	349	355
	94	SW	94	3	17	47	2	0	2	4	28	18	31	13	16	0	19	17	0	0	9	3	9	0	3	0	9	0	0	0	0	0	0	251	250
	95	SEE	95	1	5	46	2	0	0	1	15	23	35	41	15	1	34	12	0	0	22	6	7	17	1	0	0	0	0	0	0	0	0	283	302
	97	SSW	97	5	10	72	0	1	0	4	30	19	29	39	17	1	27	23	1	0	25	8	6	16	4	0	12	0	0	0	0	0	350	359	
	100	SE	100	4	9	68	0	1	0	3	29	18	28	37	16	1	25	22	1	0	23	8	6	15	4	0	12	0	0	0	0	0	331	339	
	108	Middle	108	2	5	9	0	0	0	7	9	5	2	16	2	0	14	0	0	0	9	5	0	0	0	0	9	0	0	0	0	0	93	93	
	114	NE	114	7	19	140	2	0	4	10	54	9	31	38	16	0	24	4	39	0	10	2	7	0	39	2	12	0	0	0	0	0	470	494	
		Sum		166	1212	4553	63	116	82	294	1936	549	1566	2200	416	37	1041	274	177	0	1081	175	227	179	240	133	377	73	0	52	93	91	11	17415	17480
	Total	Destinations		166	1212	4553	65	116	82	294	1936	549	1566	2200	416	37	1041	274	177	0	1074	175	227	179	240	133	377	73	0	52	93	91	11	17409	
				1	7	8	11	16	19	23	26	27	29	32	33	36	40	51	55	59	60	65	70	72	76	81	83	94	95	97	100	108	114	17415	

The Traffic Analysis Task Moves Forward



Traffic Analysis Toolbox Volume III

Guidelines for Applying Traffic Microsimulation Modeling Software

Criteria and Measures	Calibration Acceptance Targets
Hourly Flows, Model Versus Observed	
Individual Link Flows	
Within 15% for 700 veh/hr < Flow < 2,700 veh/hr	> 85% of cases
Within 100 veh/hr for Flow < 700 veh/hr	> 85% of cases
Within 400 veh/hr for Flow > 2,700 veh/hr	> 85% of cases
GEH Statistic < 5 for Individual Flows	> 85% of cases
Travel Times, Model Versus Observed	
Journey Times, Network	
Within 15% (or 1 minute, if higher)	> 85% of cases
Visual Audits	
Individual Link Speeds	
Visually Acceptable Speed-Flow Relationship	To analyst's satisfaction
Bottlenecks	
Visually Acceptable Queuing	To analyst's satisfaction

*source: Wisconsin DOT

Traffic Analysis Toolbox Volume III

Guidelines for Applying Traffic Microsimulation Modeling Software

Travel Times, Model Versus Observed

Journey Times, Network

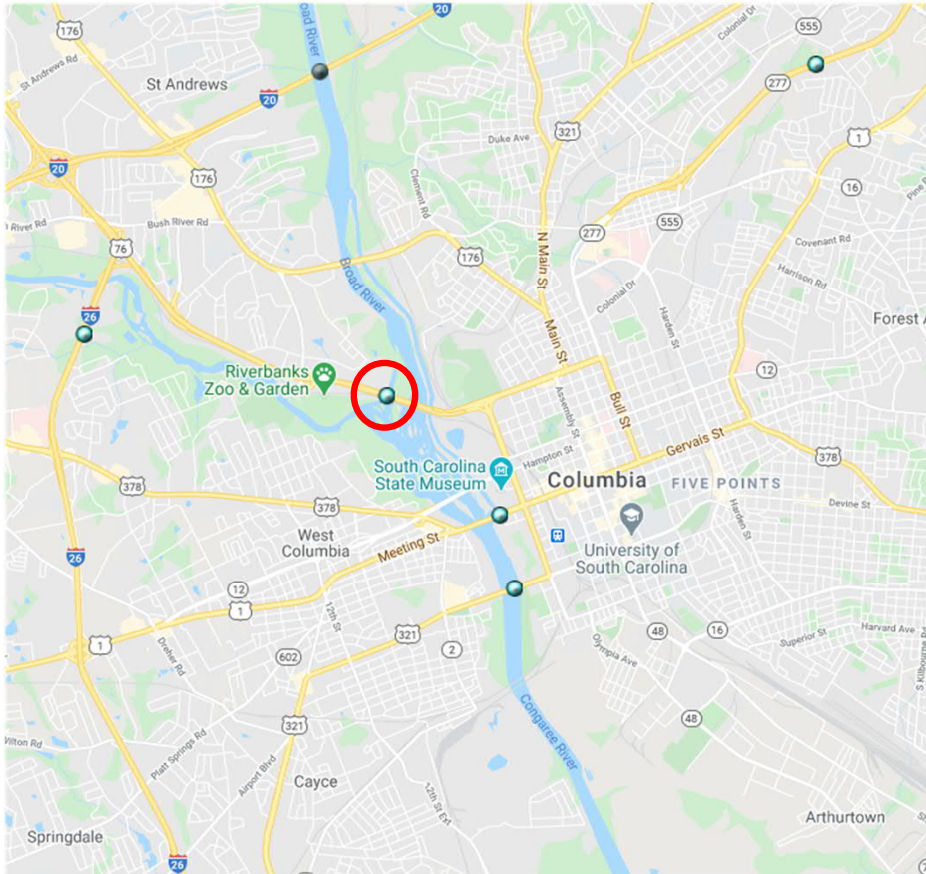
Within 15% (or 1 minute, if higher)

> 85% of cases

GEH	veh/hr	> 85% of cases
	2,700 veh/hr	> 85% of cases
GEH	Individual Flows	> 85% of cases
Travel Times, Model Versus Observed		
Journey Times, Network		
	Within 15% (or 1 minute, if higher)	> 85% of cases
Visual Audits		
Individual Link Speeds		
	Visually Acceptable Speed-Flow Relationship	To analyst's satisfaction
Bottlenecks		
	Visually Acceptable Queuing	To analyst's satisfaction

*source: Wisconsin DOT

SCDOT Traffic Polling Stations



ATR: 0020 0022 Date:

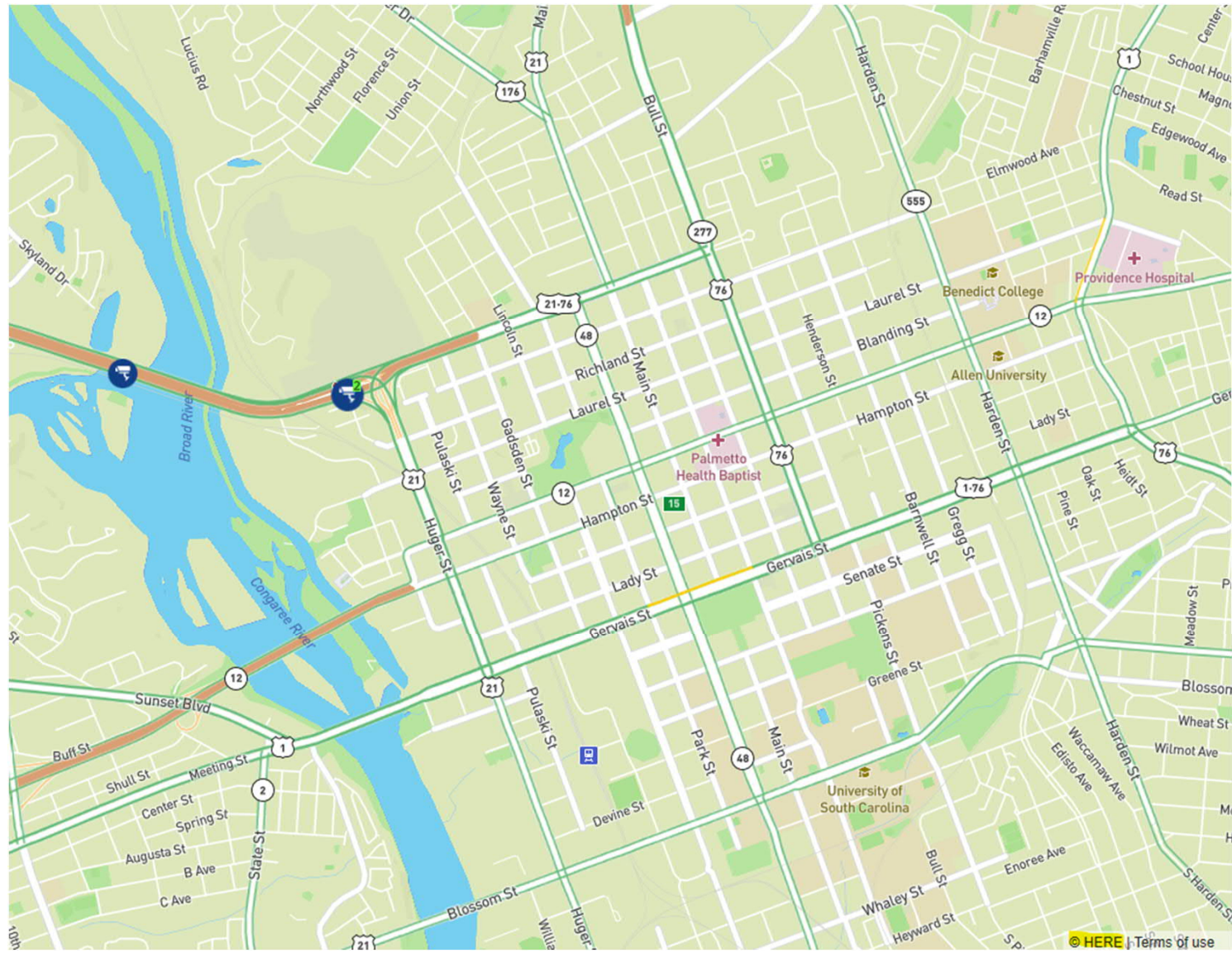
Historical data is the average of the data for all the Wednesdays in the past 3 months

Site: 0021-RICHLAND for Wednesday, 07/22/2020
Site Location: I-126 Between Broad River & Greystone Blvd (MP 1.85 - MP 3.36)

Time	Eastbound			Westbound		
	Vehicle Count		Average Speed (MPH)	Vehicle Count		Average Speed (MPH)
	Current	Historical		Current	Historical	
05:00	157	162	66	100	120	64
06:00	496	543	68	250	235	66
07:00	1594	1982	70	597	650	70
08:00	2835	3915	68	1312	1549	69
09:00	2985	4076	69	1564	1723	70
10:00	2136	2728	68	1457	1547	69
11:00	1764	2087	68	1568	1689	69
12:00	1856	2044	68	1772	2060	69
13:00	1884	2143	69	2002	2298	70
14:00	1955	2179	68	1941	2430	70
15:00	1852	2039	69	2119	2515	70
16:00	1811	2035	68	2470	3052	71
17:00	1859	2229	69	3246	4079	72
18:00	1916	2407	69	3224	3864	72
19:00	1629	1833	70	1808	2412	72
20:00	1060	1134	69	1352	1797	71

- *source: SCDOT Road Data Services

SCDOT Iteris-HERE TO THE RESCUE



*source: SCDOT 511

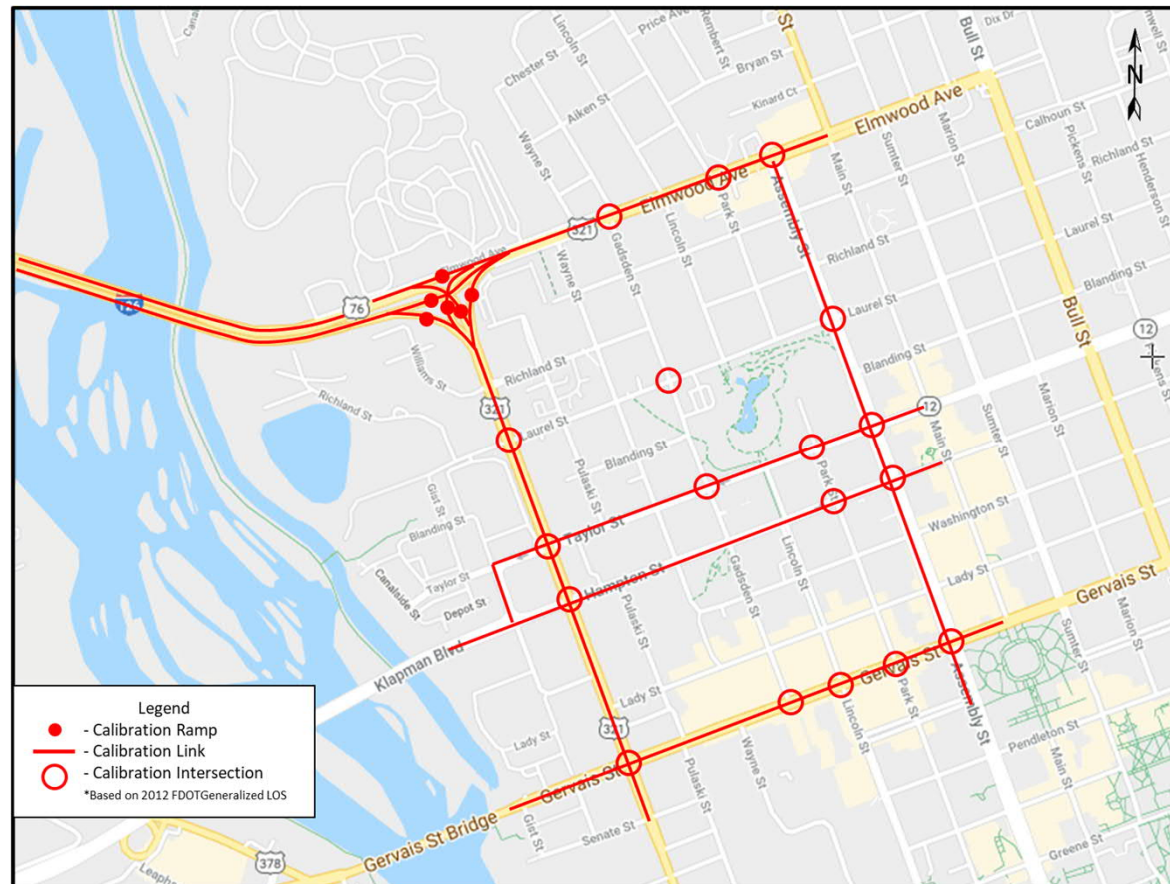
Requested Roadway Segments

Roadway		BMP	EMP	
I-126	Richland	2.351	3.676	East of Greystone I/C to End of I-126
ELMWOOD AVE - US21	Richland	2.33	2.66	End of I-126 to Main Str
HUGER ST - US21	Richland	0.75	1.86	College Str to Elmwood Ave
GERVAIS ST - US1	Richland	0	1.12	Lex Co line to Main Str
ASSEMBLY ST - SC48	Richland	0	1.2	Elmwood Ave to College Str
HAMPTON ST - SC12	Richland	0	1	Lex Co line to Park Str
TAYLOR ST - SC12	Richland	1.35	0	Main Str to Lex Co Line
LAUREL ST - S-337	Richland	2.16	1.35	Williams Str to Main Str
RICHLAND ST - L-1167	Richland	0	0.31	Lincoln Str to Main Str
CALHOUN ST - L-4636	Richland	0	0.55	Wayne Str to Main Str
LADY ST - L-170	Richland	0	0.7	Huger Str to Main Str
PARK ST - L-171	Richland	0.5	0.9	Senate Str to Hampton Str
GADSDEN ST - S-106	Richland	0.2	0.7	Richland Str to Gervais Str
WAYNE - L-1086	Richland	0	0.6	Elmwood Ave to Hampton Str
LINCOLN ST - L-168	Richland	0	0.27	Elmwood Ave to Laurel Str

Received Roadway Segments

Roadway		BMP	EMP	
I-126	Richland	2.351	3.676	East of Greystone I/C to End of I-126
ELMWOOD AVE - US21	Richland	2.33	2.66	End of I-126 to Main Str
HUGER ST - US21	Richland	0.75	1.86	College Str to Elmwood Ave
GERVAIS ST - US1	Richland	0	1.12	Lex Co line to Main Str
ASSEMBLY ST - SC48	Richland	0	1.2	Elmwood Ave to College Str
HAMPTON ST - SC12	Richland	0	1	Lex Co line to Park Str
TAYLOR ST - SC12	Richland	1.35	0	Main Str to Lex Co Line
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CALHOUN ST - L-4636	Richland	0	0.55	Wayne Str to Main Str
LADY ST - L-170	Richland	0	0.7	Huger Str to Main Str
PARK ST - L-171	Richland	0.5	0.9	Senate Str to Hampton Str
GADSDEN ST - S-106	Richland	0.2	0.7	Richland Str to Gervais Str
WAYNE - L-1086	Richland	0	0.6	Elmwood Ave to Hampton Str
LINCOLN ST - L-168	Richland	0	0.27	Elmwood Ave to Laurel Str

Calibration Segments & Intersections



Raw & Averaged Travel Data

	utc_datetime	local_datetime	timezone	vehicle_type	avg_speed	avg_spee	avg_travel_time	avg_travel_time_units
2	1/2/2019 11:00	1/2/2019 6:00	America/New_York	all	51.9 mph		1.36 mins	
3	1/2/2019 11:15	1/2/2019 6:15	America/New_York	all	55.4 mph		1.28 mins	
4	1/2/2019 11:30	1/2/2019 6:30	America/New_York	all	54 mph		1.31 mins	
5	1/2/2019 11:45	1/2/2019 6:45	America/New_York	all	61.1 mph		1.16 mins	
6	1/2/2019 12:00	1/2/2019 7:00	America/New_York	all	58.9 mph		1.2 mins	
7	1/2/2019 12:15	1/2/2019 7:15	America/New_York	all	55.9 mph		1.27 mins	
8	1/2/2019 12:30	1/2/2019 7:30	America/New_York	all	58.9 mph		1.2 mins	
9	1/2/2019 12:45	1/2/2019 7:45	America/New_York	all	59.8 mph		1.19 mins	
10	1/2/2019 13:00	1/2/2019 8:00	America/New_York	all	57.8 mph		1.22 mins	
11	1/2/2019 13:15	1/2/2019 8:15	America/New_York	all	59.9 mph		1.18 mins	
12	1/2/2019 13:30	1/2/2019 8:30	America/New_York	all	60.6 mph		1.17 mins	
13	1/2/2019 13:45	1/2/2019 8:45	America/New_York	all	57.1 mph		1.24 mins	
14	1/2/2019 20:00	1/2/2019 15:00	America/New_York	all	52.8 mph		1.34 mins	
15	1/2/2019 20:15	1/2/2019 15:15	America/New_York	all	63.6 mph		1.11 mins	
16	1/2/2019 20:30	1/2/2019 15:30	America/New_York	all	60 mph		1.18 mins	
17	1/2/2019 20:45	1/2/2019 15:45	America/New_York	all	57.7 mph		1.23 mins	
18	1/2/2019 21:00	1/2/2019 16:00	America/New_York	all	58.3 mph		1.22 mins	
2926	5/31/2019 19:00	5/31/2019 15:00	America/New_York	all	59.6 mph		1.19 mins	
2927	5/31/2019 19:15	5/31/2019 15:15	America/New_York	all	55.5 mph		1.28 mins	
2928	5/31/2019 19:30	5/31/2019 15:30	America/New_York	all	57.1 mph		1.24 mins	
2929	5/31/2019 19:45	5/31/2019 15:45	America/New_York	all	60.7 mph		1.17 mins	
2930	5/31/2019 20:00	5/31/2019 16:00	America/New_York	all	56.9 mph		1.25 mins	
2931	5/31/2019 20:15	5/31/2019 16:15	America/New_York	all	53.6 mph		1.32 mins	
2932	5/31/2019 20:30	5/31/2019 16:30	America/New_York	all	56.7 mph		1.25 mins	
2933	5/31/2019 20:45	5/31/2019 16:45	America/New_York	all	59.4 mph		1.19 mins	
2934	5/31/2019 21:00	5/31/2019 17:00	America/New_York	all	59.6 mph		1.19 mins	
2935	5/31/2019 21:15	5/31/2019 17:15	America/New_York	all	67.3 mph		1.06 mins	
2936	5/31/2019 21:30	5/31/2019 17:30	America/New_York	all	65.8 mph		1.08 mins	
2937	5/31/2019 21:45	5/31/2019 17:45	America/New_York	all	61.5 mph		1.15 mins	
2938	5/31/2019 22:00	5/31/2019 18:00	America/New_York	all	60 mph		1.18 mins	
2939	5/31/2019 22:15	5/31/2019 18:15	America/New_York	all	57.9 mph		1.23 mins	
2940	5/31/2019 22:30	5/31/2019 18:30	America/New_York	all	61.4 mph		1.15 mins	
2941	5/31/2019 22:45	5/31/2019 18:45	America/New_York	all	58.6 mph		1.21 mins	
2942								
2943								
2944								
2945								

Roadway Segment	Field Travel Time (TT) (minutes)	Raw Field TT (minutes)	Adjusted Field TT (minutes)	Model TT (minutes)	Percent Difference	Time Difference	PASS/FAIL
I-126 Eastbound	7:30-7:45	1.31	1.06	1.18	-11.15%	0.12	PASS
	7:45-8:00	1.43	1.15	1.19	-3.36%	0.04	PASS
	8:00-8:15	1.48	1.20	1.17	1.94%	-0.02	PASS
	8:15-8:30	1.59	1.28	1.17	8.59%	-0.11	PASS
I-126 Westbound	7:30-7:45	1.25	1.01	1.04	-2.18%	0.02	PASS
	7:45-8:00	1.24	1.01	1.04	-3.23%	0.03	PASS
	8:00-8:15	1.26	1.02	1.05	-2.93%	0.03	PASS
	8:15-8:30	1.26	1.03	1.04	-1.74%	0.02	PASS
Elmwood - East (Westbound)	7:30-7:45	2.15	1.59	1.65	-3.94%	0.06	PASS
	7:45-8:00	2.44	1.79	1.76	2.03%	-0.04	PASS
	8:00-8:15	2.56	1.89	1.87	0.87%	-0.02	PASS
	8:15-8:30	2.60	1.91	1.72	9.95%	-0.19	PASS
Elmwood - West (Eastbound)	7:30-7:45	1.73	1.34	1.52	-13.97%	0.19	PASS
	7:45-8:00	1.78	1.38	1.58	-14.50%	0.20	PASS
	8:00-8:15	1.82	1.41	1.57	-11.16%	0.16	PASS
	8:15-8:30	1.86	1.44	1.50	-4.30%	0.06	PASS
Huger - South (Southbound)	7:30-7:45	3.10	3.13	3.26	-4.25%	0.13	PASS
	7:45-8:00	3.37	3.40	3.28	3.42%	-0.12	PASS
	8:00-8:15	3.72	3.76	3.60	4.24%	-0.16	PASS
	8:15-8:30	3.88	3.92	3.02	23.08%	-0.90	FAIL
Huger - North (Southbound)	7:30-7:45	2.37	2.36	2.86	-21.30%	0.50	FAIL
	7:45-8:00	2.51	2.50	3.24	-29.84%	0.75	FAIL
	8:00-8:15	2.68	2.66	3.13	-17.62%	0.47	PASS
	8:15-8:30	2.77	2.75	2.65	3.61%	-0.10	PASS
Gervais (Eastbound)	7:30-7:45	2.67	2.83	3.16	-11.66%	0.33	PASS
	7:45-8:00	2.94	3.12	3.40	-8.76%	0.27	PASS
	8:00-8:15	3.08	3.27	3.21	2.04%	-0.07	PASS
	8:15-8:30	3.18	3.38	3.16	6.38%	-0.22	PASS
Hampton (Eastbound)	7:30-7:45	2.69	3.20	3.27	-2.23%	0.07	PASS
	7:45-8:00	2.72	3.24	3.19	1.42%	-0.05	PASS
	8:00-8:15	2.71	3.22	3.40	-5.41%	0.17	PASS
	8:15-8:30	2.76	3.28	3.29	-0.33%	0.01	PASS
Taylor (Westbound)	7:30-7:45	2.63	3.11	3.65	-17.54%	0.54	PASS
	7:45-8:00	2.68	3.17	3.72	-17.44%	0.55	PASS
	8:00-8:15	2.75	3.25	3.69	-13.56%	0.44	PASS
	8:15-8:30	2.76	3.26	3.62	-11.01%	0.36	PASS
Assembly - South (Southbound)	7:30-7:45	3.88	3.39	3.27	3.71%	-0.13	PASS
	7:45-8:00	4.07	3.55	3.32	6.57%	-0.23	PASS
	8:00-8:15	4.10	3.59	3.21	10.52%	-0.38	PASS
	8:15-8:30	4.12	3.60	3.12	13.36%	-0.48	FAIL
Assembly - North (Southbound)	7:30-7:45	3.11	2.72	3.41	-25.31%	0.69	FAIL
	7:45-8:00	3.24	2.83	3.26	-15.26%	0.43	PASS
	8:00-8:15	3.48	3.04	3.31	-8.91%	0.27	PASS
	8:15-8:30	3.66	3.20	3.14	1.74%	-0.06	PASS
					Percent Passing = 87.50%		

Lessons Learned

- Easier than you think
- More efficient – less field work
- Eliminates anomalies in data
- In this case, BIGGER was better